IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of   :
  STEVE A. NIXON   :

Serial No: 09/888,696   :

Filing Date: June 25, 2001   :

Title: AMBIENT TEMPERATURE CURING   :
       COATING COMPOSITION   :

Docket No: ACO 2799 US

Examiner: M. G. Moore

Group Art Unit: 1712

Mail Stop Appeal Brief – Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

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on _____ September 15, 2004 _____

_____ *Lynn Brush* _____
Lynn Brush

REPLY BRIEF

This is in reply to the Examiner's Answer ("Answer") mailed July 15, 2004. It is respectfully submitted that the record shows the rejection is not sustainable and it is requested that it be reversed.

The Examiner's Contention Is Contrary To The Art And Not Supported

The Examiner unsuccessfully attempts to manipulate the Yamaki reference into disclosing a coating composition with the presently claimed invention's "more than 70% by weight solids." Claim 1. In this attempt, she contends that "one having ordinary skill in the art would have had the skill to remove any solvent that is not necessary to the composition in Yamaki et al." Answer, pages 4-5. No support is offered by the Examiner for this statement and it is not supported by what is known in the art or by the record of the present application. If anything, the opposite is true.

It's Contrary To The Art

It is known, instead, that increasing a composition's solids content (the result intended by the Examiner's suggested removal of solvent) results in a "virtually linear" increase of viscosity. D. Stoye and W. Freitag, "Resins For Coatings", p. 33, section 4.1.1, 2nd paragraph, last sentence, and p. 285, Fig. 8.5 ("Stoye/Freitag"). (Pages 28, 29, 33, 34

and 285 of the reference enclosed in response to this assertion in the Examiner's Answer.)

It is known that it is undesirable to increase the viscosity of the coating composition. See, for example, the present specification, p.2, 1st full sentence, and Stoye/Freitag, p. 33, section 4.1.1, 2nd paragraph, last sentence. As a result, special methods are used when preparing a composition with increased solids content as discussed in the Appeal Brief, p. 4, last paragraph, and p. 5, 1st paragraph, and in Stoye/Freitag, p. 34, section 4.1.1, 1st paragraph. Accordingly, the knowledge in the art teaches away from the Examiner's contention that the skilled artisan would simply remove solvent to increase the solids content of Yamaki's composition.

It's Not Supported

Further, the record of the present application does not support the Examiner's contention. Yamaki does not lead the skilled artisan to use something other than a solvent system or a solids content anywhere near the more than 70% in the claimed invention, as shown by 1-3 below:

1. Yamaki discloses only solvent-containing systems for preparing components A, B and D of its composition
(Appeal Brief, p. 5, 3rd full paragraph, – p. 6, 3rd full paragraph; Response Under 1.116, p. 5, paragraphs 5-7; Second Response Under 1.116, p. 3, 1st full paragraph, - p. 4, 2nd full paragraph);

2. it discloses only solids contents of 36%, 40% and 40%, respectively, for components A, B and D
(Appeal Brief, p. 5, 3rd full paragraph, – p. 6, 3rd full paragraph; Response Under 1.116, p. 5, paragraphs 5-7; Second Response Under 1.116, p. 3, 1st full paragraph, - p. 4, 2nd full paragraph); and

3. it discloses only a solids content of 20% in the final composition with components A, B, C and D
(Appeal Brief, p. 4, 2nd full paragraph, and p. 6, 3rd full paragraph; Response Under 1.116, p. 6, 2nd full paragraph).

The disclosure in the Yamaki patent is limited to what it fairly teaches or suggests, which is not the same as its being limited to its examples.

Also of record is that the present specification discloses a special method to achieve a solids content of more than 70% and that Yamamori, 2002/0011177 A1, also discloses a special method to achieve a high solids content, while there is no teaching of any such special method in Yamaki (Appeal Brief, p. 3, 1st full paragraph, – p. 5, 2nd full paragraph; Response Under 1.116, p. 5, paragraphs 4-5; Second Response Under 1.116, p. 2, 4th full paragraph, - p. 3, 1st paragraph).

Appellant Did Traverse Examiner's Position

Contrary to the Examiner's assertion in the Answer, Appellant did traverse her position that "the amount of solvent in the silica dispersed component (A) is not enough to result in a final solids content outside the claimed range." Answer p. 4. The Examiner expressed this position in the 1st Advisory Action mailed October 22, 2003, and it was traversed. (Appeal Brief, p. 3, 1st full paragraph, and p. 5, second-to-last paragraph; Second Response Under 1.116, p. 3, 2nd full paragraph, and p. 4, 2nd full paragraph).

Conclusion

A prima facie case of obviousness has not been established because the three criteria have not been met: Yamaki does not suggest it would be desirable to modify its composition to contain more than 70% by weight solids, as claimed; there is no reasonable expectation, based on Yamaki's disclosure, that its composition could be made to contain more than 70% by weight solids; and Yamaki does not teach or suggest a composition containing more than 70% by weight solids Additionally, Yamaki does not enable a composition containing more than 70% by weight solids based on its complete lack of disclosure thereof.

Respectfully submitted,

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Enclosure: D. Stoye and W. Freitag, "Resins For Coatings", pages 28, 29, 33, 34 and 285

Resins for Coatings

Chemistry, Properties and Applications

Edited by
Dieter Stoye and Werner Freitag

With contributions from

G. Beuschel, J. Bieleman, P. Denkinger, W. Freitag, H. Gempeler,
G. Horn, A. Kruse, F. Lohse, C. Machate, M. Müller, B. Neffgen, J. Ott,
W. Scherzer, W. Schneider, A. Sickert, D. Stoye, W. Wieczorrek

With 47 Figures and 48 Tables

glass transition temperature T_g. For partially crystalline polymers, the transition from the hard crystalline state to the flexible state is defined as the T_g.

The glass transition temperature is a second order transition temperature, associated with a change in properties from hard/glassy/brittle to soft/flexible. At this temperature, the main chain of the polymer becomes mobile [23, 24].

At the glass transition temperature, there is a change in some of the other product properties, such as the shear modulus, the specific volume, the refractive index, the density, the dielectric constant or the thermal conductivity. The determination of the temperature-dependency of these properties is therefore used to determine the glass transition temperature. An outstanding method of determining the glass transition temperature is differential thermoanalysis (DTA) [25, 26] (see Chapter 11).

The glass transition temperature of polymers can be influenced by the polarity of the monomers, the size of the substituents on the polymer chain, the nature of copolymerization, the tacticity, the rigidity of the polymer chain, the molecular mass, the degree of branching and the degree of crosslinking.

For a copolymer formed from two monomers, the glass transition temperature of the film can be estimated in accordance with Equation 3.21.

$$1/T_G = W_1/T_{G1} + W_2/T_{G2} \qquad (3.21)$$

In this equation T_{G1} and T_{G2} are the glass transition temperatures of the respective homopolymers, and W_1 and W_2 are their proportions by mass in the copolymer.

Increased branching also reduces the glass transition temperature, as does the addition of plasticizers or the inclusion of solvents. Coating resins having a high glass transition temperature frequently possess unsatisfactory flow properties, which must be improved by use of additives.

The glass transition temperatures of coating resins are usually between 0 and 80°C. The level of the glass transition temperature has an effect on flexibility, hardness, blocking resistance, stability during sterilization of the coat, on the cold flow of the resin, on the minimum film-forming temperature of dispersions and on numerous other properties [27].

3.5   Solubility and Viscosity

The molecular chains of a resin are in general tangled with one another [28–30]. To separate them, for example by the action of solvents or by heating until the polymer flows, there are cohesive forces which must be overcome. The longer the individual molecular chain, the greater it is tangled and the more difficult it is to separate from other molecules. The higher the molecular mass of the polymer, the more difficult it is to dissolve it, and the higher the solution viscosity.

Another factor influencing the solution viscosity is the state of the polymer chain in the solution. The molecular chains may be stretched out or in a tangled bundle or may adopt any stage between these extremes. The more stretched out the molecule is, the higher the viscosity of the solution, and the greater the degree of bundled tangling the lower it is. This explains the difference in the viscosity of a single resin in different solvents. Depending on molecular mass, molecular structure and polarity, the solvents exert a strong influence on the macromolecules. Even the temperature of dissolution and the age of the solution may alter the form of the macromolecules and therefore the viscosity of their solution.

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In accordance with Einstein, the relative viscosity of a solution is related to the propor-
tion by volume ρ of the dissolved or dispersed phase in the solution, in accordance with
the equation 3.22 [31]

$$\eta_{rel} = 2.5\,\rho + 1 \tag{3.22}$$

The relative viscosity is the quotient of the solution viscosity and the inherent viscosity
of the solvent, and is therefore easy to determine

$$\eta_{rel} = \frac{\eta_L}{\eta_0} \tag{3.23}$$

The specific viscosity is

$$\eta_{sp} = \eta_{rel} - 1 = (\eta_L - \eta_0)\,\eta_0 \tag{3.24}$$

Einstein's viscosity law (Equation 3.25) gives a relationship between the specific viscos-
ity, reduced to the concentration in the solution, which is termed the viscosity number,
intrinsic viscosity or Staudinger Index, and the average density of tangling of the poly-
mer in the solution [32, 33].

$$\frac{\eta_{sp}}{c} = [\eta] = \frac{2.5}{\bar{\rho}_{equ}} \tag{3.25}$$

For solutions of infinite dilution, i.e. where $c \rightarrow 0$, the result is the intrinsic viscosity $[\eta]$,
which in accordance with the general viscosity equation for macromolecular solutions is
related to the molecular mass (see also Equation 3.16):

$$[\eta] = k_{[\eta]} \cdot M^a \tag{3.26}$$

3.6   Polarity and Spatial Occupation
by Substituents

The polarity of the polymers is essentially determined by the structure of the polymer
chains and the nature of the substituents on the polymer chain. As a result of increased
interaction between the molecules, the polarity limits the molecular mobility of the poly-
mer chains, and therefore determines the rigidity, the cohesion of the polymer chains,
and thus in turn, important properties such as glass transition temperature, crystallization
tendency, solubility, hardness, scratch resistance, elasticity and adhesion. If groups of
the same charge sign occur along the polymer chain, they repel one another and the
molecule is stretched and made rigid. Groups which occupy a relatively large space
also reduce the mobility of the molecules for steric reasons and therefore have the
same effect. This is why, for example, polyvinyl chloride, with an accumulation of polar
chlorine atoms, and polystyrene, with space-occupying phenyl groups, are harder and
more rigid than normal polyolefins. On the other hand, however, it must be borne in mind
that space-occupying groups increase the free volume of the polymer molecule and thus
bring about a reduction in the glass transition temperature, which runs counter to the
increase in the glass transition temperature brought about by the reduction of molecular
mobility.

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4   Processing States

Peter Denkinger

The surfaces of the majority of articles are provided with coatings after if not during their production [1-11]. The function of the coating is to protect the article against the effects of weathering or wear and, in addition, to give it the desired overall appearance in terms, for instance, of colour, texture or gloss. The coatings are in most cases polymer-based and are applied in thin films of usually 0.001-0.1 mm in thickness; exceptions to this are plastisols and organosols. The polymers must adhere well to the substrate to be coated and must form a pore-free film. By the process of film formation, which is termed drying, the polymers enter the solid state.

The major role is played by film formation from the liquid or pastelike state, for instance from solutions, dispersions or melts. Of particular significance is the production of films from powders, which takes place by way of the melted state. Coating from the gaseous state, such as metallization and vapour deposition, is also known.

During the procedure in which the coating materials are applied from the various processing states, drying or curing may take place as a consequence of physical and/or chemical processes. If the film is formed from a melt or by evaporation of the solvent or dispersion medium without reaction between the components of the coating material, one speaks of physical drying. With chemical drying, on the other hand, the formation of the film is accompanied by chemical reactions which lead to crosslinked macromolecules. This crosslinking procedure may involve the autocrosslinking of low molecular weight oligomers or macromolecules, or external crosslinking between low molecular weight substances such as crosslinking agents or crosslinking resins with polymers.

4.1   Film Formation from Solution

4.1.1   Polymers in Organic Solvents

In the case of dissolved resins and thermoplastic binders, film formation occurs by evaporation of the organic solvent [12]. Drying can be accelerated by increasing the temperature. In physically drying systems, the binder can be redissolved or strongly swelled by addition of solvents. Chemically drying systems can still be swollen by solvents after the drying process, but can in principle no longer be dissolved.

Films produced from solutions, in comparison with films from dispersions, are devoid of additives such as emulsifiers and organic and/or inorganic salts and for this reason exhibit better resistance to water.

The disadvantages with polymer solutions are the relatively high costs for workplace safety and environmental measures, the danger of fire and explosion, the costs of solvent recovery or solvent incineration and the toxicity of the solvents. In addition to this, the viscosity increase of high-molecular polymers as the solids content increases is virtually linear (see Figure 8.5), so that only solutions of relatively low solids content can still be processed.

In relatively recent times, low-solvent (high-solids) systems have been developed which contain from 20 to 30 per cent by mass of organic solvents and which can be processed using the conventional equipment [13, 14]. In order to obtain a workable viscosity at such high solids contents, the molecular mass of the polymers is reduced. However, the molecular mass of the physically drying binders must not reach too low a level, since otherwise the coatings may become too soft and thereby tacky or susceptible to dirt, and lose their mechanical properties such as hardness and elasticity. In chemically drying systems, the use of relatively large quantities of curing agent is necessary for crosslinking, which may lead to products of increased brittleness. In both cases, a compromise is made between optimizing the technological properties and minimizing the solvent content.

Another factor in the formation of films from solution is the differing solvent retention of the various systems.

4.1.2   Polymers in Reactive Solvents

Polymers carrying polymerizable groups are dissolved, for specific applications, in reactive solvents. Following the application of these solutions, polymerization takes place between the polymer and the solvent, with the solvent becoming part of the binder. The polymerization can be initiated by a free-radical mechanism, using free-radical initiators as is the case with unsaturated polyesters dissolved in styrene (see Chapter 6.1), or by UV light or electron beams, as is the case with radiation-curing polyacrylates (see Chapter 8) or acrylicized polyurethanes (see Chapter 7.1) which are dissolved in acrylate monomers. From the standpoint of environmental protection, these systems represent particularly environment-friendly coating products. Care, however, must be taken to ensure that the reactive solvents are of low toxicity and minimal volatility.

4.1.3   Polymers in Water

Polymers of relatively high molecular weight are generally insoluble in water. In order, despite this fact, to bring them homogeneously into the aqueous phase, the polymers must be rendered hydrophilic by the incorporation of relatively high proportions of water-friendly – i.e. usually polar – monomers. Monomers which are suitable in this respect contain, for example, an accumulation of ether groups. The water-solubility of the resulting polymers is still limited, and in most cases the only systems which can be obtained are those which, although giving clear solutions, cannot be regarded as true solutions on the basis of their physical characteristics. In respect of their particle size, they fall between solutions, colloidal solutions and microdispersions. Moreover, the products remain sensitive to water even after drying, and must therefore be crosslinked with a co-reactant in order to give useful coatings.

Another method of bringing polymers homogeneously into the aqueous phase is by introducing ionic charges into the polymers; in other words, by forming polymer salts. These polymer salts can be anionic, cationic or zwitterionic in nature: polymers with carboxyl groups form anions after neutralization with amines, polymers with amino groups form cations after neutralization with acids, whereas zwitterionic polymers carry both acidic and aminic groups (e.g. protein structures). The polymer salts are fundamentally soluble in water, and it depends critically on the molecular mass and the nature of the solvating

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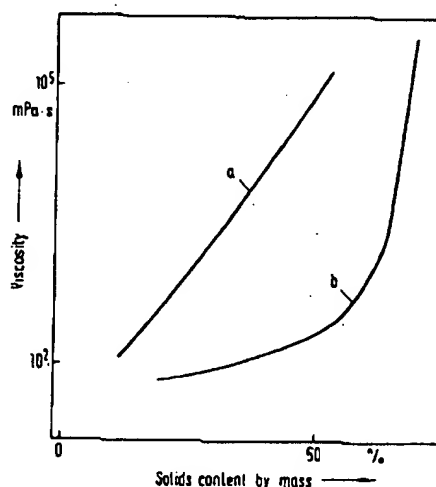mer-polymer contact
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Figure 8.5. Viscosity as a function of solids content (diagrammatic) in polymer solutions (a) and polymer dispersions (b)

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Emulsion polymers can be used directly for adhesives, paints and coatings or for the finishing of leather. For these applications it is often necessary to control the average particle size. Technically this can be achieved in a number of ways, which are dealt with in more detail in the literature [4, 100–102, 111–113].

8.6   Polymer Groups

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Polyvinyl compounds (vinyl polymers, (poly)vinyl resins, polyvinyls) are produced by polymerization of vinyl compounds $CH_2=CHR$ (Sections 8.1–8.3) or by polymer-analogous reaction of other polyvinyl compounds, as is the case, for example, with the preparation of polyvinyl alcohol from polyvinyl acetate (Section 8.6.10).

In the literature, however, not all compounds which possess the atomic grouping $CH_2=CH-$ (IUPAC name: ethenyl) are referred to as vinyl compounds. For instance, for historical reasons compounds of the type $CH_2=CHR$ where R = alkyl are also referred to as α-olefins (e.g. propene), while those where R = –COOR are called acrylates. The atomic grouping $CH_2=CH-CH_2-$, which contains the vinyl grouping, is in turn called the allyl group. The sections which follow will describe vinyl polymers which find their principal application in the paints and coatings industry. These polymers can be divided into the following major groups:

- polyolefins
- halogenated polyolefins
- polyvinyl alcohols, acetals and ethers
- polyvinyl esters
- polyacrylates
- polystyrenes
- polyvinylpyrrolidones
- indene and coumarone resins
- hydrocarbon resins